MAINE NRCS AGRONOMY TECHNICAL NOTE

SOIL WATER MANAGEMENT

The water that lands on the earth as rainfall or is added to the soil as irrigation can move in several ways. Some is intercepted by vegetation and returns to the atmosphere by evaporation. Most of the water either penetrates the soil or runs off the surface which may result in soil erosion. Part of the water infiltrating the soil percolates downward and is lost from the root zone. However in periods of low rainfall, some of this downward percolating water may move back up into the root zone by capillary action. The water remaining in the soil profile becomes soil storage water. This soil storage water becomes very important in plant production by providing water to plants during periods of low rainfall. Soil and crop management practices that maximize the infiltration and storage of water in the soil should be part of every cropping system. The following strategies and associated practices will help to sustain crop production during years of uneven rainfall and to reduce the need for supplemental irrigation water. In most cases, irrigation alone will not offset the negative impacts resulting from not implementing sound soil water management. Any supplemental irrigation that is needed is likely to be much more effective if the necessary soil water management strategies and practices are already in place. It should be noted that not all of the following strategies and practices will apply to any one crop.

Prevent or reduce runoff: Runoff removes water that could be used for crop production. Soil particles, nutrients, and pesticides may also leave the field with the runoff, possibly ending up in a water body. Practices that reduce runoff results in more water entering the soil and becoming available for plants. Conservation and management practices to prevent or reduce runoff include:

- - conducting tillage operations as close to the contour as possible,
- - minimizing furrows between the rows,
- - using tillage implements that leave small ridges,
- - conservation tillage,
- - growing a perennial crop providing permanent cover such as grass and legume forages, small fruits (blueberries, strawberries, raspberries), orchards, Christmas trees, and trees.

Improve infiltration: The portion of rain or irrigation water entering the soil is enhanced by practices that keep soil surface pores open and receptive to water penetration and that keep soil surface covered to protect it from the beating action of raindrops and the formation of crusts. Conservation and management practices to improve infiltration include:

Conservation tillage practices that leave a high percentage of the residues from the previously grown crop on or near the surface to protect the surface and reduce evaporation. The residues from the previous crop are spread uniformly on the surface. No till/strip till is a tillage system that disturbs no more than one third of the row width. Mulch till utilizes tillage implements such as, chisels and disks, to leave as much of the

crop residue on or near the surface as possible. Ridge till is a system of growing crops on preformed ridges with in between ridge areas protected by crop residue.

Applying mulches from offsite as sawdust, wood chips, manure, straw, leaves, crop residues, and other litter,

Doing deep tillage operations such as chiseling and subsoiling that break up or shatter dense subsurface layers, pans, and dense till which otherwise would restrict water infiltration and root penetration,

Minimize compaction by reducing the weight of vehicles and amount of traffic especially when the soil is moist or wet. Follow the same wheel tracks for all operations if possible.

Growing a perennial crop providing permanent cover and root system such as grass and legume forages, small fruits (blueberries, strawberries, raspberries), orchards, Christmas trees, and trees.

Increase plant-available soil moisture: The influence of organic matter deserves special attention. It is erroneously assumed that the favorable effect from organic matter is the result of the higher available water content of organic matter. This is not so. Rather, most of the benefit of organic matter is attributable to its favorable influence on soil structure and, in turn, on the volume of soil pores. Organic matter binds mineral particles into granules that are largely responsible for the loose, porous, easily managed condition of productive soils and increases the amount of water a soil can hold. Available water near the surface is especially important at the seedling stage while roots are very shallow. Conservation and management practices that increase the amount of organic matter in the soils include:

Crop rotations that include small grains, cover crops, or green manure crops,

Mulching with materials produced offsite such as sawdust, wood chips, manure, straw, leaves, crop residues, and other litter

In blueberries, pruning old blueberry growth by flail mowing in some years instead of burning while monitoring disease incidence. Regulate burning process to minimize the amount of the surface organic matter layer that is burned off. Depletion of this valuable layer by hard burns can expose rhizomes to drying conditions and injury during subsequent burn.

Reduce soil surface water evaporation: A good part of the precipitation received is usually returned to the atmosphere by evaporation from the soil surface. The most effective practices controlling evaporation are those that provide some cover to the soil, such as:

Mulching with materials produced offsite,

Conservation tillage,

Inter-seeded cover crops,

Pruning old blueberry growth by flail mowing in some years instead of burning while monitoring disease incidence. Regulate burning process to minimize the amount of the surface organic matter layer that is burned off.

One of the earlier concepts about the control of evaporation was that the formation of a natural or soil mulch was a desirable moisture conserving practice. However, years of experimentation have shown that a natural or soil mulch does not necessarily conserve moisture, especially in humid regions. Only in some tropical regions with rather distinct dry and wet seasons can a soil mulch conserve moisture.

Weed control: Transpiration by these unwanted plants can extract soil moisture far in excess of that used by the crop itself, especially row crops. Watering and feeding weeds rarely turn a profit. Tillage to control weeds is a double edge sword. Tillage controls weeds, but also contributes to soil moisture loss and soil erosion. If cultivation is the choice for weed control, it must be timely and shallow, less than 2 inches. The best time to control weeds is when they are small in the white thread stage. Sweeps should be adjusted to both undercut the weeds and to throw soil over weeds near the crop plants. Keep the number of cultivations to a minimum. For each soil disturbance, a quarter of an inch of soil moisture is lost. Herbicides have become one of the most important tools in controlling weeds while minimizing surface evaporation. Herbicides require adequate soil moisture for effective activation. Conservation and management practices that help to control weeds include:

Crop rotation
Pest management
Mulching with materials produced offsite

Crop selection: Crops to be grown should be selected according to soil properties. Soil texture, drainage, depth to underlying root limiting layer, available water holding capacity, and slope are all soil properties that need to be considered. Growing warm season grass forage or red pine on a somewhat excessively drained, course textured soil will likely be more successful than trying to grow potatoes or corn. Growing grass legume forage or Christmas trees on a strongly sloping to steep hillside will probably be more successful in the long run than trying to grow potatoes. Growing a grass-clover mixture on a somewhat excessively drained, shallow to bedrock soil will probably be more successful than growing alfalfa. Trying to grow crops on soils not suitable for the crops usually results in low returns and ultimate failure. In most cases, adding irrigation isn't likely to overcome the problems associated with the selection of the wrong crop for the soil.

Nutrient Management: Adequate soil fertility and pH levels result in vigorously growing and healthy crop plants that produce a large amount of root mass and maximizes the efficient use of soil moisture. A large root system can capture soil moisture from deeper depths and from a wider area, especially important during the periods of time when rainfall is deficient. Vigorously growing crops also produce a dense canopy in a timely manner, thus reducing soil surface water evaporation.

Timeliness of Operations: Timing of crop operations can be done to take advantage of the periods of time when soil moisture is at optimum levels. Soil moisture is usually adequate in the late spring and early summer months following snow melt and spring rains and is usually deficient during the late summer months following extended periods of time without rainfall. Planting a crop as early as possible after soil temperature becomes high enough for the crop will take advantage of the optimum levels of soil moisture. The crop is then able to develop a root-mass extensive enough to obtain water even in dry periods. Delayed planting forces the crop to try to develop a canopy and root mass during the summer months when soil moisture is most likely to be deficient.

References:

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